

## **What is claimed is:**

**[Claim 1]        1. An electronic module comprising:**

    a housing having an opening through which light enters the housing;  
    a first substrate coupled to the housing, the first substrate defining a window formed of a material that is at least semitransparent to light of a predetermined wavelength, the window being aligned with the housing so that light passing through the opening of the housing also passes through the window;

    a second substrate on a surface of the first substrate oppositely disposed from the housing, the second substrate comprising electrical conductors and having an opening that is aligned with the housing so that light that passing through the housing and the window of the first substrate also passes unimpeded through the opening;

    a chip disposed on the second substrate so as to be located over the opening therein, the chip having at least one light-sensing element aligned for sensing light of the predetermined wavelength passing through the opening in the second substrate;

    electrically-conductive connections electrically connecting the light-sensing element to the electrical conductors on the second substrate;

    an opaque layer surrounding the opening of the second substrate and coinciding with an edge of the opening, the opaque layer preventing light from entering the module through the second substrate; and

    means for preventing light from entering the module between the chip and the second substrate.

**[Claim 2]        2. The electronic module according to claim 1, wherein the second substrate is a flexible substrate laminated to the first substrate.**

- [Claim 3] 3. The electronic module according to claim 2, wherein the second substrate is flexible and comprises of an electrically-insulating material containing the electrical conductors.
- [Claim 4] 4. The electronic module according to claim 1, wherein the opaque layer is carried by and bonded to the second substrate.
- [Claim 5] 5. The electronic module according to claim 4, wherein the opaque layer is an electrically-conductive underlayer laminated to a surface of the second substrate.
- [Claim 6] 6. The electronic module according to claim 1, wherein the means for preventing light from entering the module between the chip and the second substrate comprises a body encasing the chip on the second substrate, the body being substantially opaque to light.
- [Claim 7] 7. The electronic module according to claim 6, wherein the body is substantially opaque to infrared light so as to prevent infrared light from entering through the chip.
- [Claim 8] 8. The electronic module according to claim 6, wherein the electrically-conductive connections are spaced apart on the chip to define gaps therebetween, the module further comprising an underfill material that underfills the chip on the second substrate and fills the gaps between the electrically-conductive connections to promote reliability of the electrically-conductive connections, the body encasing the underfill material on the second substrate.

**[Claim 9]**            9. The electronic module according to claim 1, further comprising means for preventing light from entering the module through the first substrate.

**[Claim 10]**            10. The electronic module according to claim 9, wherein the means for preventing light from entering the module through the first substrate comprises a portion of the housing surrounding the first substrate.

**[Claim 11]**            11. The electronic module according to claim 10, wherein the first substrate is disposed within a second opening of the housing and is surrounded by the portion of the housing.

**[Claim 12]**            12. The electronic module according to claim 1, wherein the electronic module is mounted to a motherboard, the electronic module further comprising second electrically-conductive connections that physically attach the second substrate to the motherboard and electrically connect the light-sensing element to the motherboard.

**[Claim 13]**            13. The electronic module according to claim 12, further comprising a body encasing the chip between the second substrate and the motherboard, the body being substantially opaque to light.

**[Claim 14]**            14. An optical sensing module comprising:  
a housing formed of a material that is opaque to light of a predetermined wavelength, the housing having first and second openings through which light enters and exits the housing, respectively;

a lens assembly containing at least one lens and disposed in the housing so that light entering and exiting through the first and second openings of the housing pass through the lens;

a first substrate that is at least semitransparent to light of the predetermined wavelength, the first substrate being coupled to the housing and defining a window aligned with the housing so that light passing through the first opening of the housing, the lens, and the second opening of the housing also passes through the window;

a flexible substrate bonded to a surface of the first substrate oppositely disposed from the housing, the flexible substrate comprising electrical conductors in a material that is at least semitransparent to light of the predetermined wavelength, the flexible substrate having an opening therein that is aligned with the second opening of the housing so that light that passes through the second opening of the housing and the window of the first substrate also passes through the opening;

a chip disposed on the flexible substrate so as to be located over the opening therein, the chip having at least one light-sensing element aligned to sense light of the predetermined wavelength that has passed through the opening in the flexible substrate;

solder connections physically attaching the chip to the flexible substrate and electrically connecting the light-sensing element to the electrical conductors on the flexible substrate, the solder connections being spaced apart to define gaps therebetween;

an opaque layer on the flexible substrate, surrounding the opening of the flexible substrate, and coinciding with an edge of the opening, the opaque layer preventing light of the predetermined wavelength from entering the module through the flexible substrate;

means for preventing light of the predetermined wavelength from entering the module through the first substrate; and

means for preventing light of the predetermined wavelength from entering the module through the gaps between the solder connections.

- [Claim 15]            15. The optical sensing module according to claim 14, wherein the flexible substrate comprises a flat cable of an electrically-insulating material, and the electrical conductors comprise circuitry traces for the chip and other surface-mount components on the flexible substrate.
- [Claim 16]            16. The optical sensing module according to claim 14, wherein the opaque layer is a metallic ground layer laminated to a surface of the flexible substrate or an organic coating deposited on a surface of the flexible substrate.
- [Claim 17]            17. The optical sensing module according to claim 14, wherein the means for preventing light from entering the module through the gaps between the solder connections comprises a body encasing the chip on the flexible substrate, the body being substantially opaque to light of the predetermined wavelength.
- [Claim 18]            18. The optical sensing module according to claim 17, wherein the body is substantially opaque to infrared light so as to prevent infrared light from entering through the chip.
- [Claim 19]            19. The optical sensing module according to claim 17, further comprising an underfill material that underfills the chip on the flexible substrate to promote reliability of the solder connections, the body encasing the underfill material on the flexible substrate.
- [Claim 20]            20. The optical sensing module according to claim 14, wherein the means for preventing light from entering the

module through the first substrate comprises a portion of the housing defining the second opening thereof.

[Claim 21]            21. The optical sensing module according to claim 20, wherein the portion of the housing abuts and is bonded to the flexible substrate.

[Claim 22]            22. The optical sensing module according to claim 20, wherein the first substrate is disposed within the second opening of the housing and is surrounded by the portion of the housing.

[Claim 23]            23. The optical sensing module according to claim 14, wherein the optical sensing module is mounted to a motherboard, the optical sensing module further comprising second solder connections that physically attach the flexible substrate to the motherboard and electrically connect the light-sensing element to the motherboard.

[Claim 24]            24. The optical sensing module according to claim 23, further comprising a body encasing the chip between the flexible substrate and the motherboard, the body being substantially opaque to light of the predetermined wavelength.